CLAIMS

1. An error correction method comprising:

a first step of calculating syndromes from a received word and estimating the number of bits in error from the syndromes;

a second step of generating a cubic error location polynomial from the syndromes, when it is determined that there is a two-bit error or a three-bit error;

a third step of determining a normalized cubic equation from the cubic error location polynomial, calculating roots of the normalized cubic equation, and calculating roots of the cubic error location polynomial from the roots of the normalized cubic equation; and

a fourth step of identifying an error location from the roots of the cubic error location polynomial and correcting a value of information bit of the error location.

2. The error correction method according to claim 1, wherein, said third step further comprises the steps of: translating the error location polynomial over a Galois field into a polynomial over a subfield, calculating a cubic root in the subfield, and calculating a cubic root in the Galois field from the cubic root in the subfield, so as to calculate the roots of the

normalized cubic equation.

3. The error correction method according to claim 1, wherein said fourth step comprises the steps of substituting a root of the error location polynomial for a Galois field element and determining the Galois field element corresponding to the error location by cyclic steps of comparison as the Galois field element is multiplied by a predetermined coefficient at each step.

4. An error correction method comprising:

a first step of calculating syndromes from a received word and estimating the number of bits in error from the syndromes;

a second step of generating a quadratic error location polynomial or a quartic error location polynomial depending on the number of bits in error estimated by said first step;

a third step of calculating roots of the quadratic error location polynomial generated in said second step;

a fourth step of calculating roots of the quartic error location polynomial generated in said second step; and

a fifth step of identifying an error location, based on the roots of the quadratic error location polynomial calculated in said third step or the roots of the quartic error location

polynomial calculated in said fourth step, and correcting a value at the error location.

5. The error correction method according to claim 4, wherein said fourth step comprises:

a sixth step of generating a normalized cubic equation from the quartic error location polynomial generated in said second step, and calculating roots of the normalized cubic equation;

a seventh step of generating a quadratic equation from the normalized cubic equation calculated from the roots of the normalized cubic equation calculated in said sixth step, and calculating roots of the quadratic equation;

an eighth step of generating a pair of two quadratic equations from the roots of quadratic equation calculated in said seventh step, and calculating four roots of the pair of qudratic equations; and

a ninth step of identifying the roots of the quartic error location polynomial from the four roots of the pair of quadratic equations calculated in said eighth step.

6. The error correction method according to claim 5, wherein said sixth step calculates the roots of the normalized cubic equation, by translating a polynomial of the normalized cubic equation polynomial over a Galois field into a

polynomial over a subfield, and calculating a cubic root in the Galois field from the cubic root in the subfield.

7. An error correction method comprising the steps of:

a first step of performing arithmetic operations in a subfield of a Galois field so as to calculate syndromes from a received word, and estimating the number of bits in error from the syndromes;

a second step of generating an error location polynomial in accordance with the number of bits in error estimated by said first step;

a third step of calculating roots of the error location polynomial generated by said second step: and

a fourth step of identifying an error location from the roots of the error location polynomial calculated in said third step, and correcting a value of information bit at the error location.

8. The error correction method according to claim 7, wherein said first step uses an exponential representation to represent the subfield.

9. The error correction method according to claim 7, wherein said first step uses a vector

representation to represent the subfield.

10. The error correction method according to claim 7, wherein said first step uses a normal basis to represent the subfield.

11. The error correction method according to claim 7, wherein said first step uses a dual basis to represent the subfield.

12. An error correction apparatus comprising:

error bit count estimating means for calculating syndromes from a received word and estimating the number of bits in error from the syndromes;

polynomial generating means for generating a quadratic error location polynomial or a quartic error location polynomial depending on the number of bits in error estimated by said error bit count estimating means;

polynomial solution means for determining a normalized cubic equation from the cubic error location polynomial, calculating roots of the normalized cubic equation, and calculating roots of the cubic error location polynomial from the roots of the normalized cubic equation; and correcting means for identifying an error location from the roots of the cubic error location polynomial and correcting a value of information

bit of the error location.

13. The error correction apparatus according to claim 12, wherein, said polynomial solution means calculates the roots of the normalized cubic equation, by translating the error location polynomial over a Galois field into a polynomial over a subfield, calculating a cubic root in the subfield, and calculating a cubic root in the Galois field from the cubic root in the subfield.

14. The error correction apparatus according claim 12, wherein said correcting means identifies the error location, by substituting a root of the error location polynomial for a Galois field element and determining the Galois field element corresponding to the error location by cyclic steps of comparison as the Galois field element is multiplied by a predetermined coefficient at each step.

15. The error correction apparatus according to claim 12, wherein there are provided a plurality of error correcting means for identifying the error location, by substituting a root of the error location polynomial for a Galois field element and determining the Galois field element corresponding to the error location by cyclic steps of comparison as the Galois field element is

multiplied by a predetermined coefficient at each step.

16. An error correction apparatus comprising:

error bit estimating means for calculating syndromes from a received word and estimating the number of bits in error from the syndromes;

polynomial generating means for generating a quadratic error location polynomial or a quartic error location polynomial depending on the number of bits in error estimated by said error bit estimating means;

quadratic equation solution means for calculating roots of the quadratic error location polynomial generated by said polynomial generating means;

quartic equation solution means for calculating roots of the quartic error location polynomial generated by said polynomial generating means; and

error correcting means for identifying an error location, based on the roots of the quadratic error location polynomial calculated by said quadratic equation solution means or the roots of the quartic error location polynomial calculated by said quartic equation solution means, and correcting a value at the error location.

17. The error correction apparatus

according to claim 16, wherein said quartic equation solution means comprises:

cubic equation solution means for generating a normalized cubic equation from the quartic error location polynomial generated by said polynomial generating means, and calculating roots of the normalized cubic equation;

first quadratic equation solution means for generating a quadratic equation from the normalized cubic equation calculated from the roots of the normalized cubic equation calculated by said cubic equation solution means, and calculating roots of the quadratic equation;

second quadratic equation solution means for generating a pair of two quadratic equations from the roots of quadratic equation calculated by said first quadratic equation solution means, and calculating four roots of the pair of qudratic equations; and

root identifying means for identifying the roots of the quartic error location polynomial from the four roots of the pair of quadratic equations calculated by said second quadratic equation solution means.

18. The error correction apparatus according to claim 17, wherein said cubic equation solution means calculates the roots of the normalized cubic equation, by translating a polynomial of the normalized cubic equation

polynomial over a Galois field into a polynomial over a subfield, and calculating a cubic root in the Galois field from the cubic root in the subfield.

19. An error correction apparatus comprising:

error bit count estimating means for performing arithmetic operations in a subfield of a Galois field so as to calculate syndromes from a received word, and estimating the number of bits in error from the syndromes;

polynomial generating means for generating an error location polynomial in accordance with the number of bits in error estimated by said error bit count estimating means;

polynomial solution means for calculating roots of the error location polynomial generated by said polynomial generating means: and

error correcting means for identifying an error location from the roots of the error location polynomial calculated by said polynomial solution means, and correcting a value of information bit at the error location.

20. The error correction apparatus according to claim 19, wherein said error bit count estimating means uses an exponential representation to represent the subfield.

21. The error correction apparatus according to claim 19, wherein said error bit estimating means uses a vector representation to represent the subfield.

22. The error correction apparatus according to claim 19, wherein said error bit count estimating means uses a normal basis to represent the subfield.

23. The error correction apparatus according to claim 19, wherein said error bit count estimating means uses a dual basis to represent the subfield.

24. A recording medium storing an error correction program product including steps for:

calculating syndromes from a received word and estimating the number of bits in error from the syndromes;

determining a normalized cubic equation from the cubic error location polynomial, calculating roots of the normalized cubic equation, and calculating roots of the cubic error location polynomial from the roots of the normalized cubic equation; and

identifying an error location from the roots of the cubic error location polynomial and correcting a value of information bit of the error location.

25. A recording medium storing an error correction program product including steps for:

calculating syndromes from a received word and estimating the number of bits in error from the syndromes;

generating a quadratic error location polynomial or a quartic error location polynomial depending on the number of bits in error;

calculating roots of the quadratic error location polynomial;

calculating roots of the quartic error location polynomial; and

identifying an error location, based on the roots of the quadratic error location polynomial calculated in said third step or the roots of the quartic error location polynomial, and correcting a value at the error location.

26. A recording medium storing an error correction program product including steps for:

calculating syndromes from a received word and estimating the number of bits in error from the syndromes;

generating an error location polynomial in accordance with the number of bits in error;

calculating roots of the error location polynomial: and

identifying an error location from the roots of the error location polynomial, and

correcting a value of information bit at the error location.